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# AGRICULTURAL ALTERNATIVES

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## Broccoli Production

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Broccoli is a vegetable crop that lends itself well to small-scale and part-time farming operations. Initial investment is relatively low, and many field operations, such as land preparation, planting, and harvesting, can be custom hired. Equipment needs on a small-acreage farm are not very great, and most of the equipment can be used for other purposes.

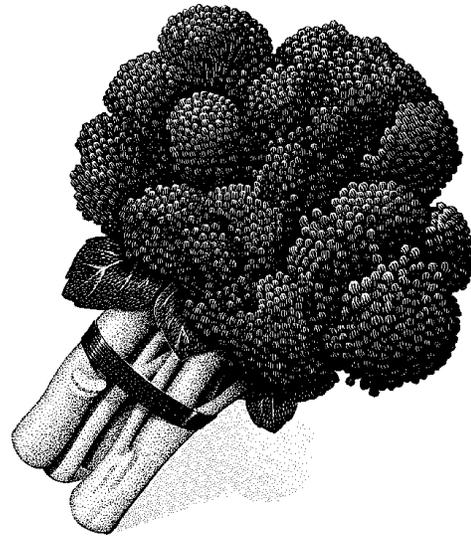
“Broccoli” can mean different things to different people. When most people think of broccoli, they are thinking of sprouting broccoli (often referred to as “Italian” or “Calabrese” broccoli). “Heading” broccoli is not a broccoli at all—it is a late season or overwintering cauliflower. Another broccoli, broccoli rabe, does not produce a head and is used as a greens crop. This publication will cover the production and marketing of sprouting broccoli.

Native to the Mediterranean region, broccoli was cultivated in Italy in ancient Roman times and was introduced into England about 1720. Unlike cauliflower, broccoli is a fairly new crop to American consumers. Broccoli was first grown commercially in California, and the first ice-packed crop was shipped east in 1924. However, broccoli did not become a crop of any significance in the United States until after World War II.

The United States is the world’s largest producer of broccoli. Most of the broccoli harvested in the U.S. is sold as fresh produce. In 1998, the U.S. produced 133,000 acres of broccoli with a value of \$554 million. (USDA Statistical Services bases value of production on total acres harvested times average price.)

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The leading broccoli-producing states are California (90 percent of the crop), Arizona, Texas, and Oregon. Broccoli also is grown on a large scale in Italy, northern Europe, and the Far East. In recent years, Pennsylvania produced 1,200 acres, valued at \$5 million.

## Marketing

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Broccoli produced in Pennsylvania usually is available from the first of June to the end of October. Broccoli cultivars recommended for Pennsylvania are listed in Table 1. Fresh-market broccoli traditionally is sold whole from open bulk containers, in portioned amounts of small florets, or as several small heads wrapped together with a rubber band. Six basic marketing alternatives are available to the broccoli grower: wholesale markets, cooperatives, local retailers, roadside stands, pick-your-own operations, and processing firms.

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In wholesale marketing, producers often contract with shippers to market and ship their broccoli for a predetermined price. If you do not use a contractor and ship your broccoli to a wholesale market yourself, your product will be subject to the greatest price fluctuations. Marketing cooperatives generally use a daily pooled cost and price, which spreads price fluctuations over all participating producers. Local retailers are another possible market, but you must take the time to contact produce managers and provide good-quality broccoli when stores require it. Roadside stands (either your own or another grower's) and pick-your-own operations provide opportunities to receive higher than wholesale prices for your broccoli, but you may have some additional expenses for advertising, building and maintaining a facility, and providing service to your customers. With pick-your-own operations, you save on harvest costs, but you must be willing to accept some waste. Depending on your location, processors may or may not be a marketing option. Processors are less likely to contract with small-acreage growers (those with less than 10 acres), and processing prices are much more volatile than fresh-market prices. For more information on marketing, consult *Agricultural Alternatives: Fruit and Vegetable Marketing for Small-scale and Part-time Growers*.

**Table 1. Recommended broccoli cultivars for Pennsylvania.**

VARIETY	
1. Baccus*	6. Emerald City*
2. Symphony*	7. Green Duke*
3. Packman*	8. Emperor*
4. Laguna*	9. Atlantic
5. Premium Crop*	10. Shogun* (BR)

\*Indicates hybrid.

NOTE: All cultivars are listed in order of maturity (early to late). BR—black rot resistant.

## Site Selection

Broccoli grows best on well-drained soils that have good water-holding characteristics. If you grow broccoli on sandy soil, irrigation is important for optimum plant growth and proper main head and side shoot development. Soil should have a pH of 5.8 to 6.6.

## Planting and Fertilization

Because broccoli is a cool-season crop, it generally is planted in the spring. You should begin planting when soil temperatures reach at least 50°F and the possibility of hard frosts (28°F or less) has passed in the area. Flower heads (the edible portion of broccoli) develop relative to ambient temperatures, and in the heat of summer, broccoli heads

maturing in July may produce flowers and seeds more quickly (four to six days) than those maturing in the cooler spring and fall periods. Broccoli heads must be closed and tight (no yellow petals showing) to be considered good quality.

While broccoli generally is transplanted in the spring, it can be sown directly from seed in late summer or early fall, when soil temperatures are in the high 60s and ambient air temperatures are in the 80s. Under these conditions, seeds generally emerge in less than seven days. Adequate soil moisture is essential for optimum broccoli-seed germination. In southern Pennsylvania, transplanting can begin in late March and in northern Pennsylvania, in mid-April. Successive plantings can occur every two weeks through August.

Optimal plant populations for broccoli are 14,000 to 24,000 plants per acre. Therefore, the amount of seed per acre that you should buy varies with plant spacing, final plant stand, and percent germination of purchased broccoli seed. Depending on the planter type used (random or precision), you should sow 0.5 to 1.5 pounds of broccoli seed per acre 12 to 18 inches apart in rows 36 inches apart. When transplanting, you should have a minimum of 11,000 plants per acre. Spacing decisions depend upon the row spacing of your equipment, your ability to irrigate, the planting date, and your specific market requirements (small or large heads).

Fertilizer rates should be based on annual soil test results. If you are unable to conduct a test, the recommended N-P-K application rates are 70-100-100 pounds per acre broadcast or 35-50-50 pounds per acre banded at planting. Cruciferous crops such as broccoli require more boron than non-cruciferous crops. You should check soil boron levels if broccoli stems are brown and hollow. Severe boron deficiency can produce browning on head surfaces. These affected heads are not marketable.

## Pest Control

Weed control can be achieved with herbicides and a good crop-rotation system. Broccoli competes fairly well with weeds, but should be kept weed free until plants reach the preheading stage. Many pretransplant and postemergence herbicides are available for broccoli, depending on the specific weed problem and the broccoli growth stage. If infestation levels are mild, cultivation can minimize weed problems.

Insects are a major problem in broccoli production. Flea beetles, cabbage loopers, imported cabbageworms, diamondback moths, and aphids all can cause crop losses. Monitoring insect populations with traps or by scouting will help you determine when you should use pesticides and how often you should spray.

Several broccoli diseases can cause crop losses. Black rot, blackleg, bacterial head rot, downy mildew, and alternaria have been observed in Pennsylvania broccoli fields. Many of these diseases can be prevented by having a good crop-rotation program and by using disease-resistant varieties.

## Harvest and Storage

Broccoli is hand harvested at a cost of about \$150 per acre. There are no mechanical harvesters for broccoli. To ensure marketing a high-quality product, you should check the broccoli heads for worms, which tend to hide underneath the florets. You also will need to grade the plants for size (head diameter generally averages 6 inches) and for flower bead tightness.

Broccoli should be cooled with packed ice or a hydro-cooler immediately after harvest. Broccoli that is cooled and maintained at 32°F and 95 to 100 percent relative humidity can be stored for 10 to 14 days. If broccoli is stored this long, however, it will begin to lose its dark green color and firmness.

## Sample Budget

Included in this publication is an annual broccoli budget that summarizes the receipts, costs, and net returns of a broccoli enterprise. This sample budget should help ensure that all costs and receipts are included in your calculations. Costs and returns are often difficult to estimate in budget preparation because they are numerous and variable. Therefore, you should think of this budget as an approximation and make appropriate adjustments in the “Your Estimate” column to reflect your specific production and resource situation. More information on the use of crop budgets can be found in *Agricultural Alternatives: Enterprise Budget Analysis*.

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## For More Information

*American Vegetable Grower*. Willoughby, Ohio: Meister Publishing Company, 1995.

*Broccoli—Fruit and Vegetable Facts and Pointers*. United Fresh Fruit and Vegetable Association, 1971.

Lorenz, O. A. and D. M. Maynard. *Knott's Handbook for Vegetable Growers*. Third Edition. New York: John Wiley and Sons, Inc., 1988.

MacNab, A. A., A. F. Sherf, and J. K. Springer. *Identifying Diseases of Vegetables (AGRS-21)*. Penn State College of Agricultural Sciences, 1998.

*Pennsylvania Commercial Vegetable Production Guide (AGRS-28)*. Penn State College of Agricultural Sciences, 2000.

### Initial resource requirements

- Land: 1 acre
- Total labor: 30 hours per year
- Capital
  - Annual production and harvest costs: \$1,530
  - Existing buildings, equipment, and fencing: \$1,600
  - Total capital: \$3,130

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## Sample Fresh-market Broccoli Budget

Summary of estimated costs and returns per acre.

Item	Quantity or number of operations	Unit	Price	Total	Your Estimate
<b>Variable costs</b>					
Custom					
Applying calcium lime	0.5	ton	\$25.00	\$12.50	_____
Pest scouting	8	acre	\$10.00	\$80.00	_____
Pesticide spraying	8	acre	\$7.20	\$57.60	_____
Fertilizer					
Nitrogen	70	pound	\$0.22	\$15.40	_____
Phosphorus	100	pound	\$0.28	\$28.00	_____
Potassium	100	pound	\$0.15	\$15.00	_____
Herbicide					
Devrinol 50W	2	pound	\$9.30	\$18.50	_____
Goal 2XL	0.19	gallon	\$96.00	\$18.00	_____
Insecticide					
Asana XL	0.06	gallon	\$111.00	\$6.94	_____
Dipel 2X	1.5	pound	\$12.20	\$18.30	_____
Orthene 75S	2.5	pound	\$10.70	\$26.60	_____
Warrior T	0.02	gallon	\$330.00	\$7.73	_____
Other variable costs					
Cultivation	3	acre	\$8.30	\$24.90	_____
Broccoli transplants	18	thsd	\$40.00	\$720.00	_____
Hand harvesting	1	acre	\$200.00	\$200.00	_____
Packing and grading	1	acre	\$180.00	\$180.00	_____
Cartons (wax lined)	550	thsd	\$0.90	\$495.00	_____
Labor	15	hour	\$10.00	\$150.00	_____
Fuel	10.21	gallon	\$0.93	\$9.50	_____
Repair and maintenance					
Tractors and implements	1	acre	\$15.00	\$15.00	_____
Interest charge	1	acre	9.5%	\$49.85	_____
<i>Total variable cost</i>				\$2,148.84	_____
<b>Fixed costs</b>					
Tractors	1	acre	\$15.86	\$15.86	_____
Implements	1	acre	\$12.32	\$12.32	_____
<i>Total fixed cost</i>				\$28.18	_____
<b>Total cost</b>				<b>\$2,177.02</b>	_____

### Net returns for five different yields and prices.

Price	Yield (1/2 carton)				
	300	400	550	650	750
\$6.00	-\$377	\$223	\$1,123	\$1,723	\$2,323
\$7.00	-\$77	\$623	\$1,673	\$2,373	\$3,073
\$8.00	\$223	\$1,023	\$2,223	\$3,023	\$3,823
\$9.00	\$523	\$1,423	\$2,773	\$3,673	\$4,573
\$10.00	\$823	\$1,823	\$3,323	\$4,323	\$5,323